UNIVERSITY OF MUMBAI
No. UG/51 of 2018-19

CIRCULAR:-

Attention of the Principals of the affiliated Colleges and Directors of the recognized Institutions in Humanities and Sci. & Tech. Faculty is invited to this office Circular No. UG/107 of 2010, dated 29th May, 2010 and Circular No. UG/108 of 2010 dated 28th May, 2010 relating to syllabus of the B.A./B.Sc. degree course.

They are hereby informed that the recommendations made by the Board of Studies in Statistics at its meeting held on 3rd May, 2018 have been accepted by the Academic Council at its meeting held on 5th May, 2018 **vide** item No. 4.69 and that in accordance therewith, the revised syllabus as per the (CBCS) for the T.Y.B.A./B.Sc. in Statistics (Sem - V & VI), has been brought into force with effect from the academic year 2018-19, accordingly. (The same is available on the University's website www.mu.ac.in).

(Dr. Dinesh Kamble)
I/c REGISTRAR

MUMBAI – 400 032
26th June, 2018

To

The Principals of the affiliated Colleges & Directors of the recognized Institutions in Humanities and Sci. & Tech. Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C/4.69/05/05/2018

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No. UG/ 51 -A of 2018 MUMBAI-400 032 26th June, 2018

Copy forwarded with Compliments for information to:-

1) The I/c Dean, Faculty of Humanities and Science & Technology,
2) The Chairman, Board of Studies in Statistics,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Co-Ordinator, University Computerization Centre,

(Dr. Dinesh Kamble)
I/c REGISTRAR

UNIVERSITY OF MUMBAI

Syllabus for the T.Y.B.A.
Programme: B.A.

Sem. V & Sem. VI

Course: STATISTICS

(As per Credit Based and Choice System
with effect from the academic year 2018–2019)

T.Y.B.A. STATISTICS Syllabus

Restructured for Credit Based and Grading System

To be implemented from the Academic year 2018-2019

T.Y.B.A. STATISTICS

Students who have opted for
ONE paper at F.Y.B.A.Statistics and TWO papers at S.Y.B.A.Statistics
will opt for
THREE papers at T.Y.B.A. Statistics (3Units)

T.Y.B.A. STATISTICS Syllabus Credit Based and Grading System
To be implemented from the Academic year 2018-2019
SEMESTER V
Theory

Course	UNIT	TOPICS	Credits	L / Unit
UASTA 501	I	Univariate Random Variables (Discrete) Bivariate probability distributions (Discrete)	3	15
	II	Standard Discrete Probability Distributions: Uniform, Bernoulli, Binomial , Poisson and Geometric distribution		15
	III	1.Negative Binomial and hyper geometric distributions. 2. Statistical computing using R –software		15
UASTA 502	I	Concepts of Sampling and Role of sampling in Research Methodology	3	15
	II	Simple random sampling		15
	III	1. Stratified Random Sampling 2. Applications of R software		15
UASTA 503	I	Mortality Tables	3	15
	II	Compound Interest and Annuities Certain		15
	III	Assurance Benefits		15
UASTA P5		Practical of Course UASTA 501, Course UASTA 502, Course UASTA 503	3	3 lecture periods per course per week

Semester VI
Theory
T.Y.B.A. STATISTICS Syllabus Credit Based and Grading System
To be implemented from the Academic year 2018-2019

Course	UNIT	TOPICS	Credits	L / Unit
UASTA 601	I	Univariate Random Variables (Continuous) Bivariate probability distributions (Continuous)	3	15
	II	Standard Continuous Probability Distributions		15
	III	Exact Sampling Distributions		15
UASTA 602	I	Analysis of Variance	3	15
	II	Design of Experiments, Completely Randomized Design Randomized Block Design and Latin Square design		15
	III	1. Missing plot and Efficiency of all three designs 2. Applications of R software		15
UASTA 603	I	Simulation	3	15
	II	Linear Regression Model		15
	III	1. Concepts of Autocorrelation, Heteroscedasticity, Multicollinearity. Concept of Logistic regression. 2. Applications of R software		15
UASTA P6		Practical of Course UASTA 601, Course UASTA 602, Course UASTA 603	3	3 lecture periods per course per week

Semester V

Course code	Title	Credits
UASTA 501	**PROBABILITY DISTRIBUTIONS and R SOFTWARE**	**3 credits (45 lectures)**
Unit 1	**Univariate Random variables(Discrete):** Moment Generating function, Cumulant Generating function- Their important properties. Relationship between moments and cumulants and their uses. Transformation of random variable(only statement and application) **Characteristic Function**: Definition and properties (without Proof) Examples of obtaining raw moments and central moments up to order four using M.G.F. and C.G.F. for discrete distributions. **Bivariate Probability distribution(Discrete):** Joint probability mass function. Its properties. Marginal and Conditional distributions. Independence of Random variables. Conditional Expectation and Variance. Transformation of Random variables and Jacobian of transformation with illustrations	15 Lectures
Unit 2	**Standard Discrete Probability distributions:** **Uniform, Bernoulli, Binomial , Poisson and Geometric distribution** The following aspects of the above distribution (wherever applicable) to be discussed : Mean , variance Measures of Skewness and Kurtosis based on moments using M.G.F and C.G.F. Nature of Probability distribution with change in the values of parameters ,Mode and Additive property. If X follows Binomial then the distribution of n-x. Recurrence relation for moments with proof. If X and Y are two independent Binomial variables , conditional distribution of X given X + Y with proof If X and Y are two independent Poisson variables, then the conditional distribution of X given X + Y with proof. Geometric Distribution- Definition in terms of no. of failures and no. of trials. Lack of memory property with proof. If X and Y are two independent and identically distributed Geometric variables, conditional distribution of X given X + Y with proof. Real life situations of Geometric distribution.	15 Lectures
Unit 3	**Part 1: (9L)** **Negative Binomial**	15 Lectures

Course code	Title	Credits
UASTA 501	**PROBABILITY DISTRIBUTIONS and R SOFTWARE**	**3 credits (45 lectures)**
	The following aspects of the above distribution (wherever applicable) to be discussed : Mean , variance, Measures of Skewness and Kurtosis based on moments using M.G.F and C.G.F. Nature of Probability distribution with change in the values of parameters, Mode and Additive property. Recurrence relation for central moments , Variance,μ_3,μ_4 using recurrence relation for central moments, Recurrence relation for probabilities. Fitting of distribution. Real life situations of Negative Binomial distributions. **Hyper geometric distribution** Definition, Mean, Variance, Limiting distribution of Hyper geometric distribution (with proof) For two i.i.d. Binomial variables X and Y ,conditional distribution of X given X+Y (with proof). Real life situations of Hyper geometric distributions. **Part 2: Statistical computing using R –software** : **Fundamentals of R - I (4L):** Entering data using c function, Creating a vector using scan function, Simple calculations, vector operations, simple functions such as log ,prod, cumsum, length, sqrt, min, summary, round, seq, rep, sort . Creating a data frame, Importing data from MS-Excel file, Using read.table command. Frequency distribution: Construction of frequency distribution using table and cut functions for discrete and continuous distributions, bivariate distribution, less than and more than cumulative frequencies, relative frequency. Plotting Diagrams and graphs using Diagrams: Bar diagrams, Pie diagram, histogram, frequency curve , ogives, box plot . **Fundamentals of R – II (2L):** Finding and plotting of probability and cumulative probability for standard discrete distributions such as binomial, Poisson, geometric.	

REFERENCES:

1. Mood A. M., GraybillF.A. Boyes D. C.: Introduction to the theory of statistics, Third Edition; McGraw-Hill Book Company.
2. Hogg R .V., Craig A.T.: Introduction to Mathematical Statistics, Fourth Edition; Collier McMillan Publishers.
3. Hogg R.V., Tanis, E. A.: Probability and Statistical Inference, Third Edition; Collier McMillan Publishers.

4. Miller I., Miller M.: .John E. Freund's Mathematical Statistics; Sixth Edition; Pearson Education Inc.
5. Hoel P.G.; Fourth Edition Introduction to Mathematical Statistics; John Wiley & Sons Inc.
6. Gupta S.C., Kapoor V.K.: Fundamentals of Mathematical Statistics; Eighth Edition; Sultan Chand & Sons.
7. Kapur J. N., Saxena H.C.: Mathematical Statistics, Fifteenth Edition; S. Chand & Company Ltd.
8. Medhi J. : Statistical Methods: An Introductory Text; Second edition; Wiley Eastern Ltd.
9. Goon A.M., Gupta M.K., Das Gupta B.: An Outline of Statistical Theory Vol. 1; Third Edition; The World Press Pvt. Ltd.
10. R for Statistics by Julie josse, Maela Kloareg, CRC Press, Taylor and Francis group
11. Statistics using R by Sharad D Gore, Sudha G Purohit, Shailaja R Deshmukh, Norosa Publishing house.

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Semester V

Course code	Title	Credits
UASTA 502	**THEORY OF SAMPLING and R SOFTWARE**	**3 credits (45 lectures)**
Unit 1	**Concepts of Sampling and Role of sampling in Research Methodology:** Basic definitions involved in sample survey and population survey. Objectives of a sample survey. Designing a questionnaire, characteristics of a good questionnaire (Questions with codes & scores are to be discussed). Reliability and validity testing by using (i) Test – Retest method (ii) Internal Consistency: (A) Kuder Richardson Coefficient (KR-20) (B) Cronbach's Coefficient Alpha. Planning, execution and analysis of a sample survey, practical problems at each of these stages. Sampling and non-sampling errors with illustrations. Study of some surveys illustrating the above ideas, rounds conducted by National Sample Surveys organization.	15 Lectures
Unit 2	**Simple random sampling:** **Simple Random Sampling for Variables:** Definition, Sampling with & without replacement (WR/WOR). Lottery method & use of Random numbers to select Simple random sample. Estimation of population mean & total. Expectation & Variance of the estimators, Unbiased estimator of variance of these estimators. (WR/WOR). **Simple Random Sampling for Attributes:** Estimation of population proportion. Expectation & Variance of the estimators, Unbiased estimator of variance of these estimators. (WR/WOR). Estimation of Sample size based on a desired accuracy in case of SRS for variables & attributes. (WR/WOR).	15 Lectures
Unit 3	**Part 1(8L)** **Stratified random sampling:** Need for Stratification of population with suitable examples. Definition of Stratified Sample. Advantages of stratified Sampling. **<u>Stratified Random Sampling:</u>** Estimation of population mean & total in case of Stratified Random Sampling (WOR within each strata). Expectation & Variance of the unbiased estimators, Unbiased estimators of variances of these estimators. Proportional allocation, Optimum allocation with and without varying costs. Comparison of Simple Random Sampling, Stratified Random Sampling	15 Lectures

Course code	Title	Credits
UASTA 502	THEORY OF SAMPLING and R SOFTWARE	3 credits (45 lectures)
	using Proportional allocation & Neyman allocation. **Part 2(7L)** **Applications of R software I:** Calculation of measures of central tendency, absolute and relative measures of dispersion, measures of skewness and kurtosis for discrete and continuous frequency distributions. **Applications of R software II:** Listing simple random samples with replacement and without replacements for n = 2, n=3. Verifying formulae for mean and variance. R software programs for stratified random sampling: Selection of stratified samples. Calculation of mean and variance for Population mean and Population total.	

REFERENCES:

1. Cochran W.G.:Sampling Techniques; 3rd Edition; Wiley(1978)
2. Murthy M.N.:Sampling Theory and methods; Statistical Publishing Society. (1967)
3. Des Raj:Sampling Theory; McGraw Hill Series in Probability and Statistics. (1968).
4. Sukhatme P.V. and Sukhatme B.V.:Sampling Theory of Surveys with Aplications; 3rd Edition; Iowa State University Press (1984).
5. Gupta S. C. andKapoor V.K.:Fundamentals of Applied Statistics; 3rd Edition; Sultan Chand and Sons (2001).
6. SinghDaroga, Chaudhary F.S.: Theory and Analysis of Sample Survey Designs:, Wiley Eastern Ltd. (1986).
7. Sampath S.: Sampling Theory and Methods, Second Edition (2005),Narosa.
8. MukhopadhyayParimal:Theory and Methods of Survey Sampling, (1998),Prentice Hall Of India Pvt. Ltd.
9. R for Statistics by Julie josse, Maela Kloareg, CRC Press, Taylor and Francis group
10. Statistics using R by Sharad D Gore, Sudha G Purohit, Shailaja R Deshmukh, Norosa Publishing house.

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Semester V

Course code	Title	Credits
UASTA 503	**APPLIED STATISTICS - I**	**3 credits (45 lectures)**
Unit 1	**Mortality Tables:** Various Mortality functions. Probabilities of living and dying. The force of mortality. Estimation of μ_x from the mortality table. Mortality table as a population model. Stationary population. Expectation of life and Average life at death. Central Death rate.	15 Lectures
Unit 2	**Compound Interest and Annuities Certain:** Accumulated value and present value, nominal and effective rates of interest. Discount and discounted value, varying rates of interest. Equation of value. Equated time of payment. Present and accumulated values of annuity certain (immediate and due) with and without deferment period. Present and accumulated values of- i) increasing annuity ii) increasing annuity when successive installment form a) arithmetic progression b) geometric progression Redemption of loan **(Annuity with frequency different from that with which interest is convertible – Not to be done)**	15 Lectures
Unit 3	**Assurance Benefits:** Present value of Assurance benefits in terms of commutation functions of - i) Pure endowment assurance, ii) Temporary assurance, iii) Endowment assurance, iv) Whole life assurance, v) Special endowment assurance, vi) Deferred temporary assurance, vii) Deferred whole life assurance. Present value in terms of commutation functions of Life annuities and Temporary life annuities (immediate and due) Net Level annual premiums for the assurance plans mentioned above.	15 Lectures

Course code	Title	Credits
UASTA 503	APPLIED STATISTICS - I	3 credits (45 lectures)
	(i. Increasing whole life assurance ii. Increasing temporary assurance iii. Present values of variable and increasing life annuities (immediate and due) – Not to be done)	

References:

1. Neil A.: Life Contingencies, First edition, Heineman educational books, London
2. Dixit S.P., Modi C.S., Joshi R.V.: Mathematical Basis of Life Assurance:, First edition, Insurance Institute of India
3. Gupta S.C., Kapoor V.K.: Fundamental of Applied Statistics, Fourth edition, Sultan Chand and Sons, India
4. R for Statistics by Julie josse, Maela Kloareg, CRC Press, Taylor and Francis group
5. Statistics using R by Sharad D Gore, Sudha G Purohit, Shailaja R Deshmukh, Norosa Publishing house.

Semester VI

Course code	Title	Credits
UASTA 601	**PROBABILITY and SAMPLING DISTRIBUTIONS**	**3 credits (45 lectures)**
Unit 1	**Univariate Random variables(Continuous):** Moment Generating function, Cumulant Generating function- Their important properties. (without proof) Relationship between moments and cumulants and their uses. Transformation of random variable(only statement and application) **Bivariate Probability distribution(Continuous):** Joint probability density function. Their properties. Marginal and Conditional distributions. Independence of Random variables. Conditional Expectation and Variance. Coefficient of Correlation. Transformation of Random variables and Jacobian of transformation with illustrations. **Standard Continuous Probability distributions:** Rectangular, Exponential: The following aspects of the above distributions(wherever applicable) to be discussed: Mean, Median, Mode & Standard deviation. Moment Generating Function, Additive property, Cumulant Generating Function. Skewness and Kurtosis (without proof). *****	15 Lectures
Unit 2	**Standard Continuous Probability distributions:** Triangular, Gamma (with Single & Double parameter), Beta (Type I & TypeII). The following aspects of the above distributions(wherever applicable) to be discussed: Mean, Median, Mode & Standard deviation. Moment Generating Function, Additive property, Cumulant Generating Function. Skewness and Kurtosis (without proof). Interrelation between the distributions. **<u>Normal Distribution:</u>** Mean, Median, Mode, Standard deviation, Moment Generating function, Cumulant Generating function, Moments &Cumulants (up to fourth order). Recurrence relation for central moments, skewness& kurtosis, Mean absolute deviation. Distribution of linear function of independent Normal variables. Fitting of Normal Distribution. Central Limit theorem for i.i.d. random variables. Log Normal Distribution: Derivation of mean & variance.	15 Lectures

Course code	Title	Credits
UASTA 601	**PROBABILITY and SAMPLING DISTRIBUTIONS**	**3 credits (45 lectures)**
Unit 3	**Exact sampling distributions:** **Chi-square distribution:** Concept of degrees of freedom. Mean, Median, Mode & Standard deviation. Moment generating function, Cumulant generating function. Additive property, Distribution of the sum of squares of independent Standard Normal variables. Sampling distributions of sample mean and sample variance and their Independence for a sample drawn from Normal distribution (without proof). **Applications of Chi-Square:** Test of significance for specified value of variance of a Normal population. Test for goodness of fit & Test for independence of attributes (derivation of test statistics is not expected), Yates' correction. **t- distribution:** Mean, Median, Mode & Standard deviation. Distribution of ratio of a Standard Normal variable to the square root of an independent Chi-square divided by its degrees of freedom. Asymptotic properties. Student's t. **Applications of t:** Confidence interval for: Mean of Normal population, difference between means of two independent Normal populations having the same variance. Test of significance of: mean of a Normal population, difference in means of two Normal populations (based on: (i) independent samples with equal variances. (ii) dependent samples). **F-distribution:** Mean, Mode & Standard deviation. Distribution of : Reciprocal of an F variate, Ratio of two independent Chi-squares divided by their respective degrees of freedom. Interrelationship of F with t-distribution, Chi-square distribution & Normal distribution. **Applications of F:** Test for equality of variances of two independent Normal populations.	15 Lectures

REFERENCES:

1. Mood A. M., Graybill F.A., Boyes D. C.: Introduction to the theory of statistics, Third Edition; McGraw-Hill Book Company.
2. Hogg R.V., Craig A.T.: Introduction to Mathematical Statistics, Fourth Edition; Collier McMillan Publishers.
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4. Miller I., Miller M.: .John E. Freund's Mathematical Statistics; Sixth Edition; Pearson Education Inc.
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6. GuptaS.C., Kapoor V.K.: Fundamentals of Mathematical Statistics; Eighth Edition; Sultan Chand & Sons.
7. KapurJ.N., Saxena H.C.: Mathematical Statistics, Fifteenth Edition; S. Chand & Company Ltd.
8. MedhiJ. : Statistical Methods: An Introductory Text; Second edition; Wiley Eastern Ltd.
9. GoonA.M., GuptaM.K., DasGupta B. :An Outline of Statistical Theory Vol. 1; Third Edition; The World Press Pvt. Ltd.

Semester VI

Course code	Title	Credits
UASTA 602	**Analysis of Variance , Designs of Experiments and R software**	**3 credits (45 lectures)**
Unit 1	**Analysis of Variance:** Introduction, Uses, Cochran's Theorem (Statement only). One way classification with equal & unequal observations per class, Two way Classification with one observation per cell. Mathematical Model, Assumptions, Expectation of various sums of squares, F- test, Analysis of variance table. Least square estimators of the parameters, Variance of the estimators, Estimation of treatment contrasts, Standard Error and Confidence limits for elementary treatment contrasts. **Concept of ANOCOVA.**	15 lectures
Unit 2	**Design of Experiments:** Concepts of Experiments, Experimental unit, Treatment, Yield, Block, Replicate, Experimental Error, Precision. Principles of Design of Experiments: Replication, Randomization & Local Control. Efficiency of design D1 with respect to design D2. Choice of size, shape of plots & blocks in agricultural & non-agricultural experiments. **Completely Randomized Design (CRD) , Randomized Block Design (RBD) and Latin Square Design (LSD):** Mathematical Model, Assumptions, Expectation of various sums of squares, F-test, Analysis of variance table. Least square estimators of the parameters, Variance of the estimators, Estimation of treatment contrasts, Standard error and Confidence limits for elementary treatment contrasts.	15 lectures
Unit 3	**Part 1 (5L)** **Missing plot and Efficiency of all three designs.** Efficiency of RBD relative to a CRD. Efficiency of LSD relative to RBD, CRD. Missing plot technique for one missing observation in case of RBD & LSD **Part 2(10L)** **Probability using R-software** Finding and plotting of probability and cumulative probability for standard continuous distributions such as exponential, normal, Chi- square , t, F.	15 lectures

Course code	Title	Credits
UASTA 602	**Analysis of Variance , Designs of Experiments and R software**	**3 credits (45 lectures)**
	Testing of hypothesis using normal distribution: Testing for • Single population mean • Two population means • single population proportion • Two population proportions **ANOVA and Designs of Experiments using R software:** Anova for one way and two way classification and LSD	

REFERENCES

1. Cochran W.G. and Cox G.M.: Experimental Designs; Second Edition;John Wiley and Sons.
2. KempthorneOscar :The Design and Analysis of Experiments, John Wiley and Sons.
3. Montgomery Douglas C.:Design and Analysis of Experiments; 6thEdition;John Wiley & Sons.
4. Das M.N.and Giri N.C.: Design and Analysis of Experiments, 2nd Edition; New Age International (P) Limited;1986.
5. Federer Walter T.:Experimental Design, Theory and Application; Oxford & IBH Publishing Co. Pvt. Ltd.
6. Gupta S.C.and Kapoor V.K.: Fundamentals of Applied Statistics; 3rd Edition; Sultan Chand and Sons (2001).
7. Winer B.J.:Statistical Principles in Experimental Design, McGraw Hill Book Company

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Semester VI

Course code	Title	Credits
UASTA 603	**APPLIED STATISTICS- II**	**3 credits (45 lectures)**
Unit 1	**Simulation :** Scope of simulation applications. Types of simulation, Monte Carlo Techniqueof Simulation. Elements of discrete event simulation. Generation of random numbers. Sampling from probability distribution. Inverse Method. Generation of random observations from - (i) Uniform distribution, (ii) Exponential distribution, (iii) Gamma Distribution, (iv) Normal distribution. Concepts of Inventory problems. Simulation technique applied to inventory and queuing models.	15 Lectures
Unit 2	**Linear Regression Model:** Multiple Linear Regression Model with two independent variables. Assumptions of the model, Derivation of ordinary least square (OLS) estimators of the regression coefficients, Properties of least square estimators (without proof) Concept of R^2 and adjusted R^2. Procedure of testing of (i) Overall significance of the model, (ii) significance of individual coefficients, (iii) significance of contribution of additional independent variable to the model, Confidence Intervals for the regression coefficients.	15 Lectures
Unit 3	**Part 1(5L):** **Concepts of Autocorrelation, Heteroscedasticity, Multicollinearity.** **Concept of logistic regression.** **Part II(10L):** **Testing of hypothesis using Chi, t, and F distributions.** **Correlation and Regression analysis using R software:** Scatter diagram, Karl Pearson's correlation coefficient between two variables, Multiple Correlation. Linear regression for one explanatory variable, Multiple regression analysis	15 Lectures

REFERENCES

1. GujrathiDamodar, Sangetha:Basic Econometrics: , Fourth edition, McGraw-Hill Companies
2. Kantiswaroop and Gupta Manmohan:Operations Research, 4th Edition; S Chand & Sons.
3. BrosonRichard :Schaum Series book in O.R., 2nd edition Tata Mcgraw Hill Publishing Company Ltd.

4. SasieniMaurice, Yaspan Arthur and Friedman Lawrence: Operations Research: Methods and Problems,(1959), John Wiley & Sons.
5. Sharma J K.:Mathematical Models in Operations Research, (1989), Tata McGraw Hill Publishing Company Ltd.
6. Sharma S.D.: Operations Research, 11th edition, KedarNath Ram Nath& Company.
7. Taha H. A.: Operations Research:., 6th edition, Prentice Hall of India.
8. Sharma J.K.: Quantitative Techniques For Managerial Decisions, (2001), MacMillan India Ltd.

Assessment of Practical Core Courses Per Semester per course

1. Semester work, Documentation, Journal + Viva ---------- 10 Marks.
2. Semester End Practical Examination ---------- 40 Marks

Semester End Examination

Theory: At the end of the semester, Theory examination of three hours duration and 100 marks based on the three units shall be held for each course.

Pattern of **Theory question** paper at the end of the semester for **each course** :

There shall be Five Questions of twenty marks each.
Question 1 based on all Three units. Ten sub-questions of two marks each.
Question 2 based on Unit I (Attempt any TWO out of THREE)
Question 3 based on Unit II (Attempt any TWO out of THREE)
Question 4 based on Unit III (Attempt any TWO out of THREE)
Question 5 based on all Three Units combined. (Attempt any TWO out of THREE)

Practicals: At the end of the semester, Practical examination of **2** hours duration and 40 marks shall be held for **each course**.
Marks for journal and viva in each paper should be given out of 10.

Pattern of **Practical question** paper at the end of the semester for **each course** :

There shall be Four Questions of ten marks each. Students should attempt all questions. Question 1 based on Unit I, Question 2 based on Unit II, Question 3 based on Unit III, Question 4 based on all Three Units combined.
Students should attempt **any two** sub questions out of the **three** in each Question.

Workload:

Theory : 3 lectures per week per course.

Practicals: 3 lecture periods per course per week per batch. All three lecture periods of the practicals shall be conducted in succession together on a single day. Practicals for R programming should be conducted on Computer.

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